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UNFAIR COMPETITION

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September 26, 2000

Our Case Docket No. 20000389.ORI

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BOX PATENT APPLICATION

The Commissioner of Patents and Trademarks
Washington, D. C. 20231

Sir:

Enclosed for filing is the patent application of inventor, BRADLEY J. WESSMAN, for "MEDICAL LEAD AND METHOD FOR MEDICAL LEAD MANUFACTURE" for filing together with the following:

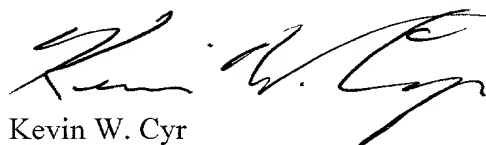
- (1) One copy of six (6) sheets of informal drawings;
- (2) The Declaration, Power of Attorney and Petition executed by the inventor; and
- (3) One executed Verified Statement Claiming Small Entity Status - Small Business Concern; and
- (4) An Assignment to MicroNet Medical, Inc., executed by the inventor; and
- (5) The filing and recording fees are calculated as follows:

Basic filing fee	\$ 345.00
Total number of claims in excess of 20, times \$9.00	\$ 72.00
Number of independent claims, minus 3, times \$39.00	\$ 78.00
Surcharge fee (\$130.00) for filing of multiple dependent claim(s) . .	\$ 0
Recording fee for assignment	\$ 40.00
Total	\$535.00

A check in the amount of \$535.00 is enclosed to cover the filing and recording fees. The Commissioner is authorized to charge any fees or refund any overpayment under 37 C.F.R. 1.16 and 1.17 which may be required for filing of the above-referenced paper to Deposit Account No. 08-1265.

Yours very truly,

NIKOLAI, MERSEREAU & DIETZ, P.A.


Kevin W. Cyr

KWC/acl
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09/26/00

Express Mail No. EL692946876US

PATENT APPLICATION

Docket No. 20000389.ORI

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Re App : BRADLEY J. WESSMAN : September 26, 2000

For : MEDICAL LEAD AND METHOD FOR MEDICAL
LEAD MANUFACTURE

CERTIFICATE OF MAILING VIA EXPRESS MAIL

BOX PATENT APPLICATIONS

Commissioner of Patents and Trademarks
Washington, D. C. 20231

Sir:

I hereby certify that the attached patent application consisting of nine (9) pages of specification, four (4) pages of claims, abstract, one copy of six (6) sheets of patent drawings, two (2) pages of an executed Declaration, Power of Attorney, and Petition, an executed Assignment, a Recordation Form Cover Sheet (2pgs.), two (2) pages of an executed Verified Statement Claiming Small Entity Status - Small Business Concern, a transmittal cover letter, and a check in the amount of \$535.00 in payment of the filing and recording fees, are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and are addressed to: BOX PATENT APPLICATIONS, Commissioner of Patents and Trademarks, Washington, D. C. 20231, under Express Mail Post Office to Addressee Label No. EL692946876US.

Respectfully submitted,

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PATENT APPLICATION

ATTORNEY DOCKET NO. 20000389.ORI

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Re App : BRADLEY J. WESSMAN

For : MEDICAL LEAD AND METHOD FOR
MEDICAL LEAD MANUFACTURE

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY
STATUS (37 CFR 1.9(f) and 1.27(c)) - SMALL BUSINESS CONCERN**

I hereby declare that I am

- ☒ owner of the small business concern identified below:
- ☐ an official of the small business concern empowered to act on behalf of the concern identified below:

MicroNet Medical, Inc.
A Corporation of Minnesota.
1839 Buerkle Road
White Bear Lake, MN 55110
A Small Business Concern.

I hereby declare that the above-identified small business concern qualifies as a small business concern as defined in 13 CFR 121.12, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees to the United States Patent and Trademark Office, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention entitled " MEDICAL LEAD AND METHOD FOR MEDICAL LEAD MANUFACTURE " by inventor, Bradley J. Wessman, described in the specification filed herewith.

If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights in the invention is listed below* and no rights

to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e). *NOTE: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27).

NAME

ADDRESS

() Individual (☒) Small Business () Nonprofit Organization

NAME

ADDRESS

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I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate (37 CFR 1.28(b)).

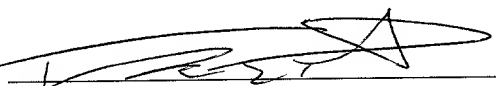
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this Verified Statement is directed.

NAME OF PERSON SIGNING:

TITLE OF PERSON IF OTHER THAN OWNER:

ADDRESS OF PERSON SIGNING:

SIGNATURE



DATE 9-22, 2000.

MEDICAL LEAD AND METHOD FOR MEDICAL LEAD MANUFACTURE

BACKGROUND OF THE INVENTION

5 - Field of the Invention:

The present invention relates to a medical leads and particularly to a method of medical lead manufacture and medical leads having a conductive pad connecting a band electrode to a conductor.

 - Description of the Related Art:

10 Implantable leads form an electrical connection between a pulse generator or other electronic device and a tissue or structure in the body. For example, leads transmit electric signals used to stimulate cardiac or nerve tissue in one direction and signals generated by sensors placed in proximity to particular organs or tissues in the opposite direction. Leads typically include one or more electrodes at the lead's distal
15 end. The electrodes are designed to form an electrical connection with a tissue or organ. Most leads also include a lead connector at the lead's proximal end. Lead connectors are adapted to electrically and mechanically connect leads to the pulse generators or other electronic medical devices. A conductor connects the electrode to the lead connector. Commonly, the conductor takes the form of a single or multifilar
20 wire coil. Although, there is an increasing interest in using stranded cables as conductors. Regardless of the conductor's form, an insulating material typically surrounds the conductors. Spinal chord stimulation leads are typically formed with individually insulated conductors surrounded by a separate lead body tube. Together, the conductor and the insulating material form the lead body. The lead body couples
25 the lead connector at the proximal end with the electrode at the distal end.

 Manufacturing leads is costly. A significant portion of the cost is allocated to electrically connecting the conductors to the various electrodes, sensors and connectors used in the industry. Forming a secure electrical junction has proven difficult and time consuming. Laser welds are commonly used to connect the
30 conductors to the electrodes. The conductors are typically helically wound into a coil for increased reliability and flexibility. Band electrodes are typically connected to conductors by welding in an operation separate from the application of the lead body tube. Once the band electrodes are connected to the conductors, an extruded tube is placed over the conductor coil and welded band electrodes are connected to the lead

body tube by insert molding or RF welding. Band electrodes may also be connected to a conductor by etching away a region of insulator, applying a coating of electrically conductive adhesive, and then placing the band electrode around the conductor. This etching method is complex, not amenable to automation and expensive. Therefore, a need exists for a method that reduces complexity and is easily automated to reduce production costs.

In another method of attachment, band electrodes are electrically connected to coiled conductors by placing a soft metal in a hole cut into an insulating sleeve. An electrode is placed over the metal and crimped or swaged to bring the electrode, soft metal and coiled conductors into electrical contact and to secure the electrode to the lead body. The crimping or swaging method of connection results in electrical connections between the conductor and the band electrode that may fail. Further, swaging to electrically connect an electrode to a conductor is time consuming and difficult to implement with the modern reduced diameter leads. Hence, a need exists for an improved manufacturing technique to secure band electrodes to conductors that reduces the time, complexity and cost while increasing reliability.

In addition, current manufacturing techniques frequently require adding elements, such as collars, when connecting a band electrode to a coil. The added elements increase the lead's diameter near the weld. In application, a uniform diameter weld would result in a smaller lead. A smaller diameter lead is desired to allow placement in restricted spaces such as the epidural space or cardiac veins to reduce the effects of implanted lead on the patient. Further, a smaller lead allows for a smaller introducer that reduces the trauma associated with implantation and similarly a smaller removal sheath when explanting the lead. Hence, there exists a need to reduce the diameter of the welds used to secure electrodes to conductors in implantable medical leads.

The present invention meets these needs and provides other advantages and improvements that will be evident to those skilled in the art.

SUMMARY OF THE INVENTION

The present invention provides a lead and method for lead construction that reduces the time, complexity and costs of producing implantable electrical leads by

providing a novel connection between the conductors and an electrode, connector or sensor.

5 The medical lead includes a lead body, a conductive pad and a band. The lead body is comprised of an insulator and at least one conductor. The insulator includes at least one welding region exposing at least one conductor. The welding region may be in the form of a groove cut in the insulator. When in the form of a groove, the welding region typically is cut parallel to the orientation of the conductor. The conductive pad is secured within the welding region to electrically connected to the conductor to the pad. The conductive pad may be composed of stainless steel, MP35N, platinum, gold, silver, copper, vanadium or other metal. The conductive pad may be electrically connected to the conductor by welding, conductive adhesives, crimping or other methods. Alternative to the conductive pad, an elongated conductive element may be used to electrically connected to the conductor to the pad. The elongated conductive element can be a wire, a ribbon wire, a cable, or other elongated form. The elongated conductive element may be composed of stainless steel, MP35N, platinum, gold, silver, copper, vanadium or other metal. The elongated conductive element may be electrically connected to the conductor by welding, conductive adhesives, crimping or other methods. The band is welded to the conductive pad to electrically connect the band to the conductor. The band may be a band electrode, a band connector, a sensor, or other element electrically secured to medical leads. The band may include a plurality of projections on an inner wall of a lumen. The projections space the inner wall from an outer surface of the lead body. Three or more projections may be positioned around the inner wall to center the lead body within the lumen during assembly.

25 The method for manufacturing a medical lead includes forming a welding region, securing a conductive pad within the welding region, and securing a band to the conductive pad. The welding region is typically formed by cutting through the insulator to expose the conductor. The welding region can cut with a laser, typically an excimer laser, or can be mechanically cut. The conductive pad is secured within the welding region adjacent the conductor. The conductive pad can be secured within the welding region using a weld, crimping conductive adhesives or other method. The band is secured to the conductive pad to electrically connect the band to the

conductor. To secure the band, a weld is formed between the conductive pad and the band. A yttrium-arsenic-garnet laser may be used to form the weld.

Alternatively to the use of a conductive band, an elongated conductive element may be substituted. The proximal end of the elongated conductive element is secured
5 conductor within the welding region. The band is then positioned around the lead body and over the welding region. The distal end of the elongated conductive element is then electrically connected to the band. The elongated conductive element may be electrically connected to the band by welding.

10 BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a perspective view of a lead in accordance with the present invention;

Figure 2 illustrates a longitudinal cross-sectional view of a of a lead showing an embodiment of the connection between a coiled conductor and a band with a
15 conductive pad;

Figure 3 illustrates a top view of a lead, as shown in Figure 2, without the band;

Figure 4 illustrates a longitudinal cross-sectional view of a of a lead showing the connection between a coiled conductor and a band with an elongated conductive
20 element;

Figure 5 illustrates a top view of a lead, as shown in Figure 4, without the band;

Figure 6A illustrates a cross-sectional longitudinal view of a band electrode, as shown in Figures 4 and 5; and

25 Figure 6B illustrates and end view of the band electrode, as in Figure 6A.

DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a medical lead and a method for lead manufacture. The invention is described generally in the context of an electrode for a
30 neurostimulating lead and a method for manufacturing a neurostimulating lead as a specific example for illustrative purposes only. The appended claims are not intended to be limited to any specific example or embodiment described in this patent. It will be understood by those skilled in the art that leads in accordance with the present

invention may be used for a wide variety of applications including, but not limited to, leads and catheters for use with cardiac monitoring devices, cardiac rhythm management devices, ablation devices, mapping devices, neurostimulating devices, neuromonitoring devices or other medical devices using leads or catheters. Further, in the drawings described below, the reference numerals are generally repeated where identical elements appear in more than one figure.

Figure 1 illustrates an embodiment of a lead 10 made in accordance with the present invention. Leads designed for neurostimulation typically have two or more longitudinally spaced band electrodes at the lead's distal end. Lead 10, as shown, includes a lead body 12 and four band electrodes 14. Lead 10 is generally configured to transmit an electric signal from a pulse generator (not shown) to a spinal nerve or peripheral nerve. Thus, electrodes 14 are typically located at the distal end of lead 10. Lead body 12 includes a flexible lead insulator surrounding one or more conductors. The conductors are electrically coupled to the band electrodes. In addition, a lead connector 15 is typically located at the proximal end of lead body 12 to electrically couple the conductors to the pulse generator.

Typically, lead body 12 is a flexible, elastomeric structure having a round cross-section. Alternatively, lead body's cross-section could be any number of shapes appropriate for the specific application. The figures and the following description generally refer to round cross-sectional shape for lead bodies for exemplary purposes. The lead insulator is generally configured to insulate the conductors and to present a smooth biocompatible external surface to body tissues. Thus, the lead insulator is typically coextensive with the conductor or conductors. When a plurality of conductors form a multipolar lead, individual conductors are typically electrically isolated from one another. The insulator material is typically selected based on biocompatibility, biostability and durability for the particular application. The insulator material may be silicone, polyurethane, polyethylene, polyimide, polyvinylchloride, PTFE, ETFE, or other materials known to those skilled in the art. Moreover, alloys and blends of these materials may also be formulated to control the relative flexibility, torqueability, and pushability of the lead. Depending on the particular application, the diameter of the lead body may be as small as 2 French or smaller for neurological and myocardial mapping/ablation leads and can be sizes larger than 12 French for other applications.

The conductors may take the form of solid wires, drawn-filled-tube (DFT), drawn-brazed-strand (DBS), stranded cables or other forms that will be recognized by those skilled in the art. The conductors may be composed of stainless steel, MP35N, or other conductive materials known to those skilled in the art. The number, size, and composition of the conductors will depend on particular application for the lead.

At least one band electrode 14 is positioned at the distal end of lead body 12 for electrically engaging a target tissue or organ. In addition, at least one band connector 15 is positioned at the proximal end of the lead body for electrically connecting the conductors to the neurostimulator. For purposes of the present invention, band electrodes 14 and band connectors 15 are collectively referred to as bands. The bands are typically made of a conductive material such as platinum, gold, silver, platinum-iridium, stainless steel, MP35N or other conductive metals or alloys thereof known to those skilled in the art. The bands are typically composed of a material thin enough to allow for welding of the elements to the underlying conductive pad, as discussed below. For neurostimulation, band electrodes 14 are typically between 1 and 10 millimeters long and have a diameter between about 2 and about 8 French but are more typically between 4 and 6 French. Typically, band connectors 15 have a size and configuration appropriate to connect the lead to a particular neurostimulator.

Figure 2 illustrates the details of an embodiment of the connection between a conductor 22 and band electrode 14 in accordance with the present invention. Band electrodes are the point of electrical contact between the conductors and the patient. Although discussed in the context of a band electrode, one skilled in the art will recognize that the following description is also applicable to a band connector, a sensor or other electrical element. For exemplary purposes, band electrode 14 and lead body 12 is configured for two welds at a welding region 20. At least one weld is typically utilized. In the particular embodiment, the same conductor is connected to band electrode 14 twice. Figure 2 illustrates a longitudinal cross-section of a lead body having four spirally wound conductors for exemplary purposes. The lead body is shown with four conductors. The conductors may be visible through the insulating material when the insulating material is translucent.

Figure 3 illustrates a top view of a lead body having the insulating material removed to form welding region 20 by exposing conductor 22. Welding region 20

provides access to conductor(s) 22 for electrically connecting the band electrode to conductor 22. Welding region 20 is typically formed by removing the insulating material from lead body 10. The insulating material is removed to expose small sections of the individual conductors 22 without breaching an inner lumen, if present.

5 Typically, an excimer laser is used to remove the insulating material. When the insulator is removed by laser, welding region 20 may be in the form of a groove in the insulator. Although, welding region 20 may take a variety of forms and orientations that expose a sufficient surface area of conductor 22 to form an electrical connection with a conductive pad, discussed below. When in the form of a groove, welding
10 region 20 is typically formed such that the groove runs parallel to conductor 22. Regardless of the form of welding region 20, enough insulating material is removed to expose sufficient surface area of conductor 22 for securing a conductive pad or elongated conductive element to the conductor.

Referring to Figures 2 and 3, a conductive pad 24 is positioned within welding
15 region 20 during manufacture to facilitate the electrical connection of band electrode 14 and conductor 22. A weld 26 is typically used to secure the conductive pad 24 in electrical contact with conductor 22. Alternatively, conductive pad 24 may be secured using an adhesive. Conductive pad 22 may be composed of any of a variety of conductive materials that can be welded or secured with adhesives. The metal may
20 be stainless steel, MP35N, Pt-Ir, platinum, silver, gold, copper, vanadium or other metal that will be recognized by one skilled in the art upon review of this disclosure. Conductive pad 24 is positioned within welding region 20 so that conductive pad 24 is in electrical contact with conductor 22. Typically, conductive pad 24 is welded to the conductor prior to placing band electrode 14 over the welding regions and conductive
25 pads 24. A pulsed Neodymium:yttrium-arsenic-garnet (YAG) laser may be used to weld conductive pad 24 to conductor 22. Figure 2 shows a side view of a cross-section of two grooves 20 that expose two regions of the same conductor 22. Conductive pads 24 are welded to conductor 22 within grooves 20. Band electrode 14 is placed over lead body 12 of lead 10 and welded to conductive pads 24, thereby
30 securing band electrode 14 to lead body 12 and electrically connecting conductor 22 and band electrode 14. Band electrode 14 may be further secured to lead body 12 by swaging, crimping and/or adhesives. Alternatively, the band electrode may be secured to the lead body by heating the lead body. Heating the lead body stress-

relieves the plastic increasing the outside diameter and securing the band electrode over the lead body. In addition, heating the lead body may be used to create a lead having a uniform diameter band and lead body.

Figures 4 and 5 illustrate the details of another embodiment of a connection between conductor 22 and a band connector 15 in accordance with the present invention. Band connectors are the point of electrical contact between the medical device using the lead and the conductors within the lead. Although discussed in the context of a band connector, one skilled in the art will recognize that the following description is also applicable to band electrodes, sensors or other electrical elements.

10 An elongated conductive element 34 is used to electrically connect the band to conductor 22. The elongated conductive element may be in the form of a wire, a ribbon wire, or a cable. The metal may be stainless steel, MP35N, Pt-Ir, platinum, silver, gold, copper, vanadium or other metal that will be recognized by one skilled in the art upon review of this disclosure. A distal end of elongated conductive element

15 34 is electrically connected to band connector 15. Typically, the electrical connection employs a weld 28, although a conductive adhesive or other method of conductively attaching may be used. Figure 4 shows a longitudinal cross-section of a lead body having four spirally wound conductors. One or more welding regions 20 are formed through the insulating material by removing the insulating material from lead body

20 10. Typically, the insulating material is removed with a laser. The proximal end of elongated conductive element 34 is positioned within welding region 20 so that the proximal end is in electrical contact with conductor 22. Typically, the proximal end is secured to conductor 22 prior to placing band connector 15 over lead body 12. Again, the proximal end is typically welded although a conductive adhesive or other method

25 of conductively attaching the proximal end may be used. The elongated conductive element 34 and attached proximal end are typically configured to allow band connector 15 to pass over elongated conductive element 34 during assembly. The distal ends of elongated conductive elements 34 may then be electrically connected to band connector 15.

30 Figures 4 and 5 illustrate a single exemplary connection between conductor 22 and band connector 15 by welds 26 and 28. Thus, figure 4 shows only one groove 20 exposing conductor 22. The proximal end of elongated conductive element 24 is positioned within groove 20 is welded to conductor 22. Band connector 15 is placed

over lead body 12 and welded to elongated conductive element 34, thereby electrically connecting conductor 22 and band connector 15. Band connector 15 may be further secured to lead body 12 by swaging, crimping, adhesives and/or insert molding. In addition, swaging may reduce the outside diameter of lead connector 15 to permit the manufacture of a lead of uniform diameter. Further, lead body 12 may be expanded by heating to create a uniform diameter for lead connector 15.

Figures 6A and 6B illustrate an embodiment of a band which may be used in conjunction with the present invention. Although discussed in the context of a band connector, one skilled in the art will recognize that the following description is also applicable to band electrodes, sensors or other electrical elements. Band connector 15 includes an inner wall 42 defining a lumen 44. At least one projection 46 is formed on the inner wall 42. Projections 46 define a space between inner wall 42 and an outer surface of the lead body during assembly. Projections 46 may be molded on the inner surface; formed by crimping the exterior surface of the band; or added as separate elements secured to the inner surface of the band. Projections 46 have a height 45 which defines the amount of space between the outer surface of the lead body and inner wall 42. Height 45 is generally selected to allow conductive pads 24 and/or conductive elements 34 to pass beneath the inner wall during assembly. Typically, three projections are provided at positions around the circumference of band connector 15 to center band connector 15 over lead body 12 during assembly. Centering band connector 15 so that height 45 is substantially the same around the circumference of the lead body assures clearance of the conductive element during assembly.

CLAIMS

1. A medical lead, comprising:
 - a lead body having an insulator and at least one conductor, wherein the insulator includes at least one welding region;
 - 5 at least one conductive pad within the welding region, the conductive pad electrically connected to the conductor; and
 - a band welded to the conductive pad to electrically connect the band to the conductor.
- 10 2. A medical lead, as in Claim 1, wherein the welding region comprises a groove cut in the insulator.
3. A medical lead, as in Claim 2, wherein the groove runs parallel to the conductor.
- 15 4. A medical lead, as in Claim 1, wherein the conductive pad is electrically connected to the conductor using a method selected from the group consisting of welding, conductive adhesives, crimping.
- 20 5. A medical lead, as in Claim 1, wherein the conductive pad is composed of a metal selected from the group consisting of stainless steel, MP35N, platinum, gold, silver, copper and vanadium.
- 25 6. A medical lead, as in Claim 1, wherein the band is selected from the group consisting of a band electrode, a band connector, and a sensor.
7. A medical lead, as in Claim 1, the band further comprising a plurality of
30 projections on an inner wall of a lumen, wherein the projections space the inner wall from an outer surface of the lead body.

8. A medical lead, as in Claim 7, wherein at least three projections are positioned around the inner wall to center the lead body within the lumen.
9. A medical lead, comprising:
- 5 a lead body having an insulator and at least one conductor, wherein the insulator includes at least one welding region;
- at least one elongated conductive element having a proximal end electrically connected to the conductor within the welding region; and
- 10 a band welded to the elongated conductive element to electrically connect the band to the conductor.
10. A medical lead, as in Claim 9, wherein the welding region comprises a groove cut in the insulator.
- 15 11. A medical lead, as in Claim 10, wherein the groove runs parallel to the conductor.
12. A medical lead, as in Claim 9, wherein the elongated conductive element is selected from the group consisting of wire, ribbon wire, and cable.
- 20 13. A medical lead, as in Claim 9, wherein the elongated conductive element is electrically connected to the conductor using a method selected from the group consisting of welding, crimping and conductive adhesives
- 25 14. A medical lead, as in Claim 9, wherein the elongated conductive element is composed of a material selected from the group consisting of stainless steel, MP35N, platinum, gold, silver, copper and vanadium.
- 30 15. A medical lead, as in Claim 9, wherein the band is selected from the group consisting of a band electrode, a band connector, and a sensor.

16. A medical lead, as in Claim 9, the band further comprising a plurality of projections on an inner wall of a lumen, wherein the projections space the inner wall from an outer surface of the lead body.
- 5 17. A medical lead, as in Claim 16, wherein at least three projections are positioned around the inner wall to center the lead body within the lumen.
18. A method for manufacturing a medical lead, comprising:
cutting a welding region in a lead body to expose a conductor;
10 securing a conductive pad within the welding region adjacent the conductor; and
securing a band to the conductive pad to electrically connect the band to the conductor.
- 15 19. A method, as in Claim 18, wherein the welding region is cut with an excimer laser
20. A method, as in Claim 18, wherein the conductive pad is secured within the welding region by a method selected from the group consisting of welding, crimping
20 and adhesives.
21. A method, as in Claim 19, wherein the band is secured to the conductive pad by welding with a yttrium-arsenic-garnet laser.
- 25 22. A method for manufacturing a medical lead, comprising:
cutting a welding region in a lead body to expose a conductor;
electrically connecting a proximal end of an elongated conductive
element to the conductor within the welding region;
positioning a band around the lead body and over the welding region;
30 and
electrically connecting a distal end of an elongated conductive element to the band.

23. A method, as in Claim 22, wherein the welding region is cut with an excimer laser.

24. A method, as in Claim 22, wherein the elongated conductive element is
5 electrically connected within the welding region by welding.

25. A method, as in Claim 24, wherein the elongated conductive element is welded within the welding region with a yttrium-arsenic-garnet laser.

10 26. A method, as in Claim 22, wherein the elongated conductive element is electrically connected to the band by welding.

27. A method, as in Claim 26, wherein the band is welded to the elongated conductive element with a yttrium-arsenic-garnet laser.

15

28. A band for a medical lead, comprising a plurality of projections on an inner surface of a lumen to provide clearance between a lead body and the inner surface for passage of one of a conductive pad or an elongated conductive element during assembly.

20

29. A band, as in Claim 28, comprising at least three projections circumferentially spaced around the inner surface of the lumen.

ABSTRACT

A lead employing a connection between a conductor and an electric element is provided. The connection includes a conductive pad electrically connected to at least one conductor and the electric element electrically connected to the conductive pad.

- 5 The conductive pad can further include an elongated element to connect the pad to the electric element. The method for connecting a conductor to an electric element is also provided. The method includes forming a groove in the insulator of a lead body to expose the conductor. Placing a conductive pad within the groove and electrically connecting a conductive pad to the conductor. An electric element is then placed over
- 10 the conductive pad and the electric element is electrically connected to the conductive pad.

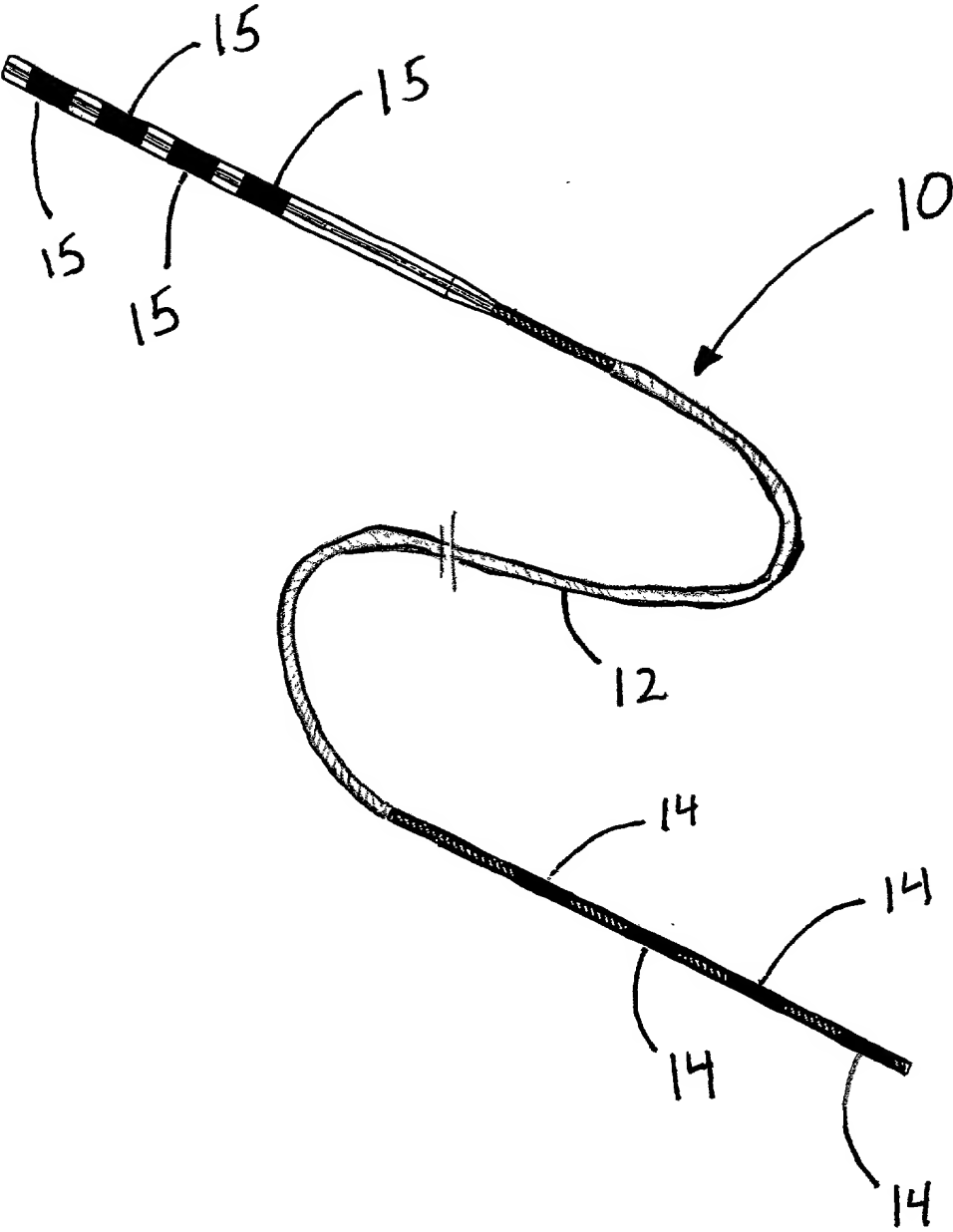


Fig. 1

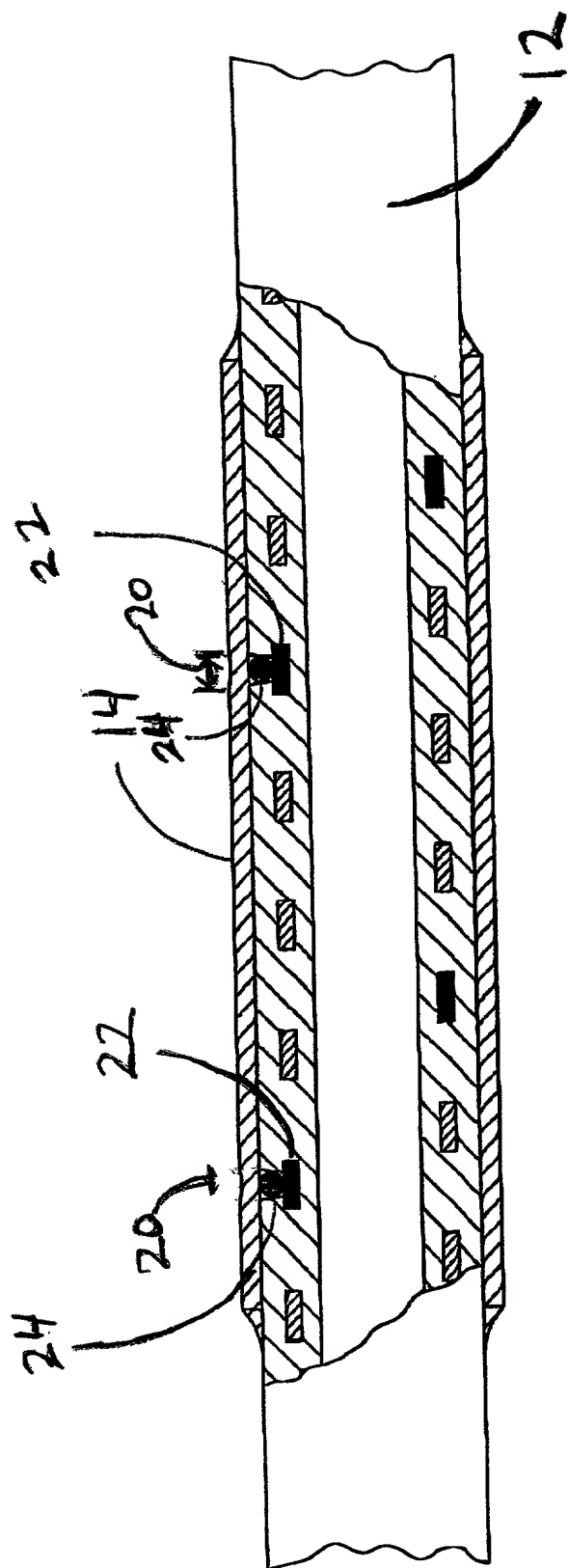


Fig 2

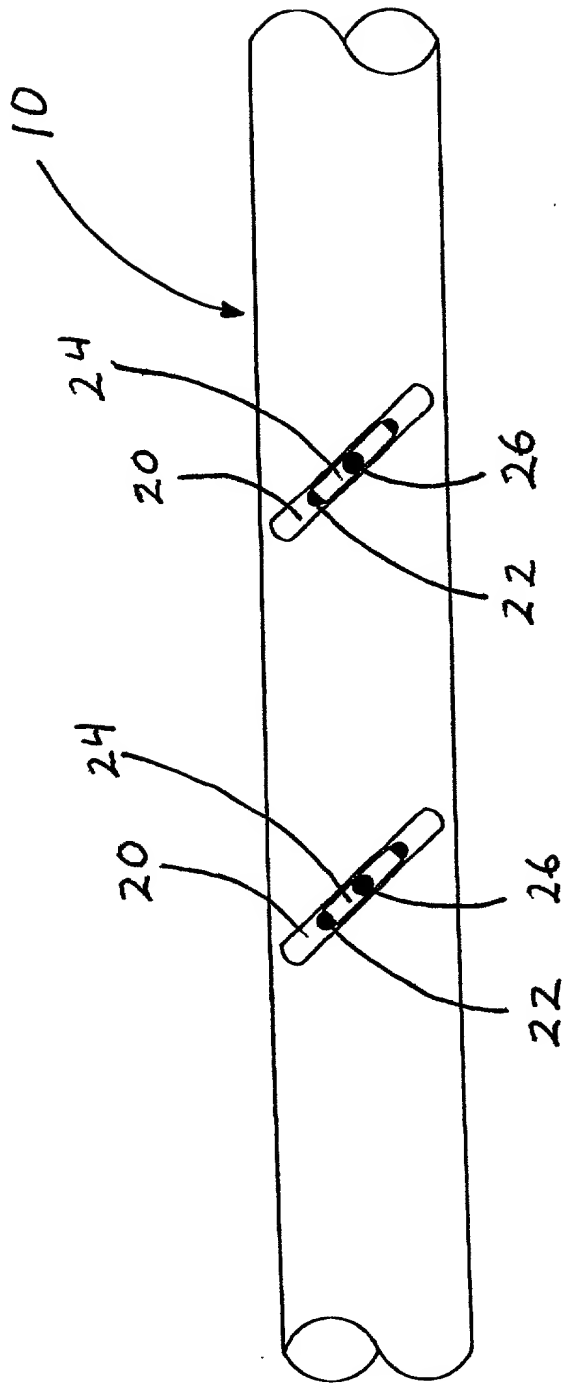


Fig. 3

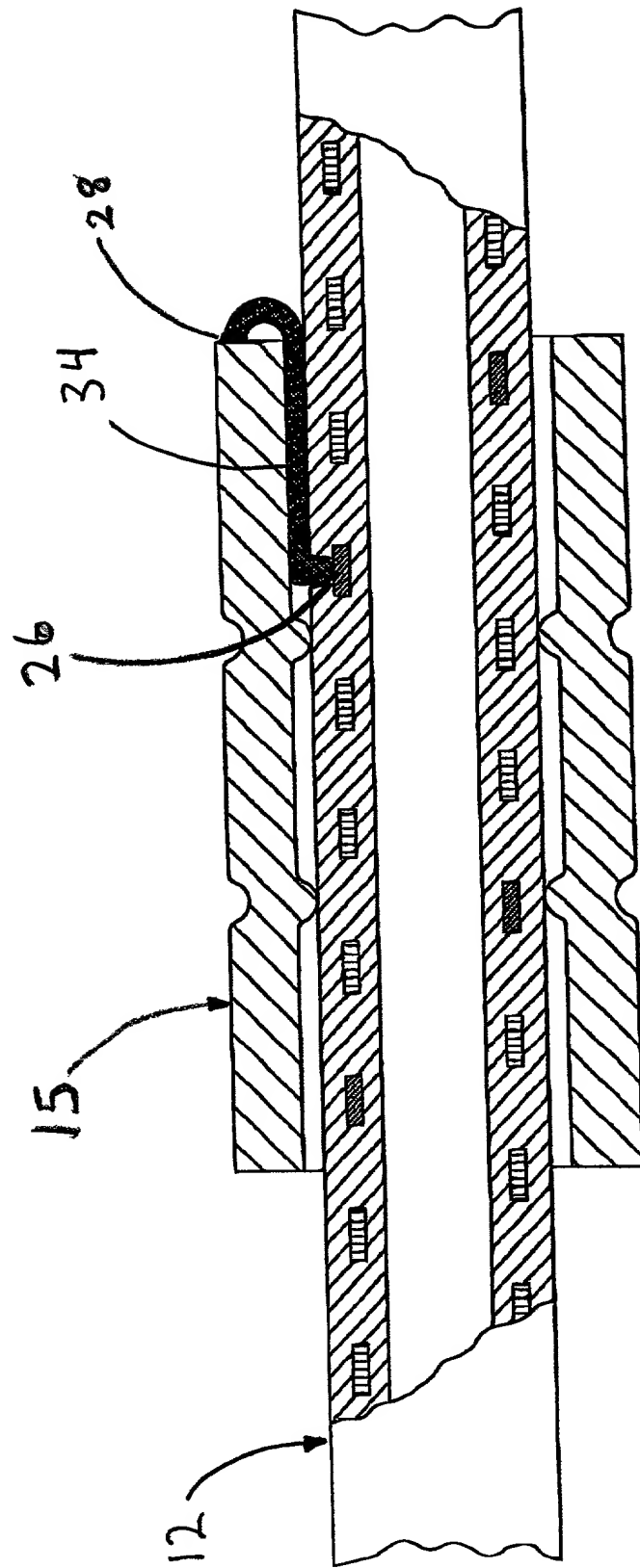


Fig. 4

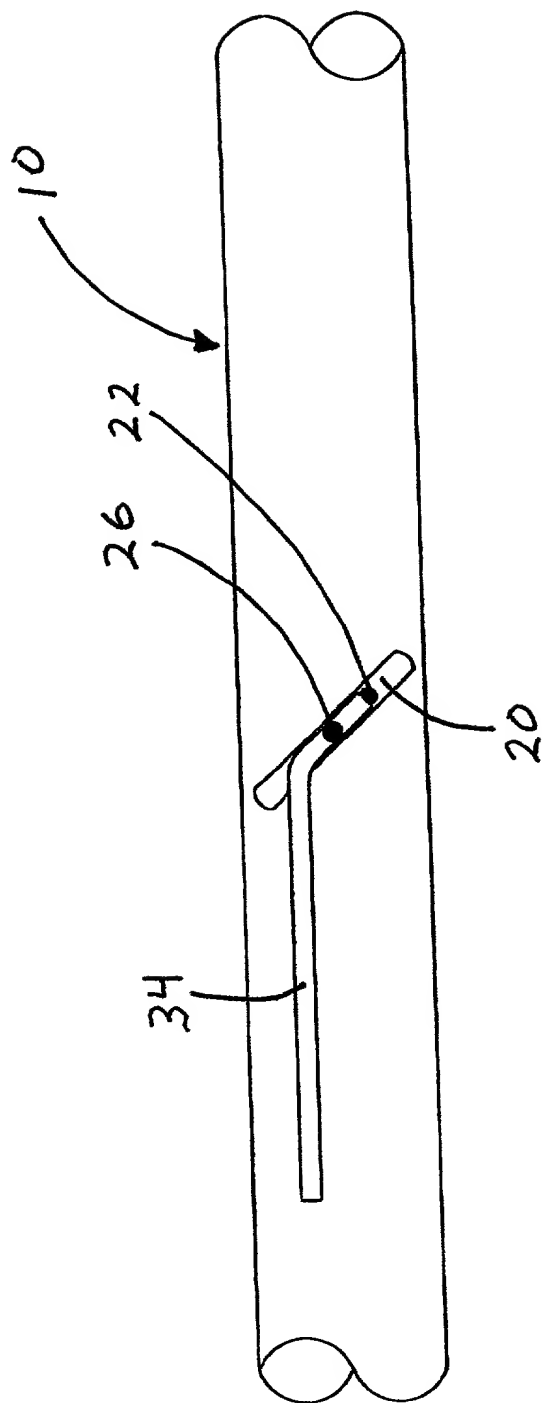


Fig. 5

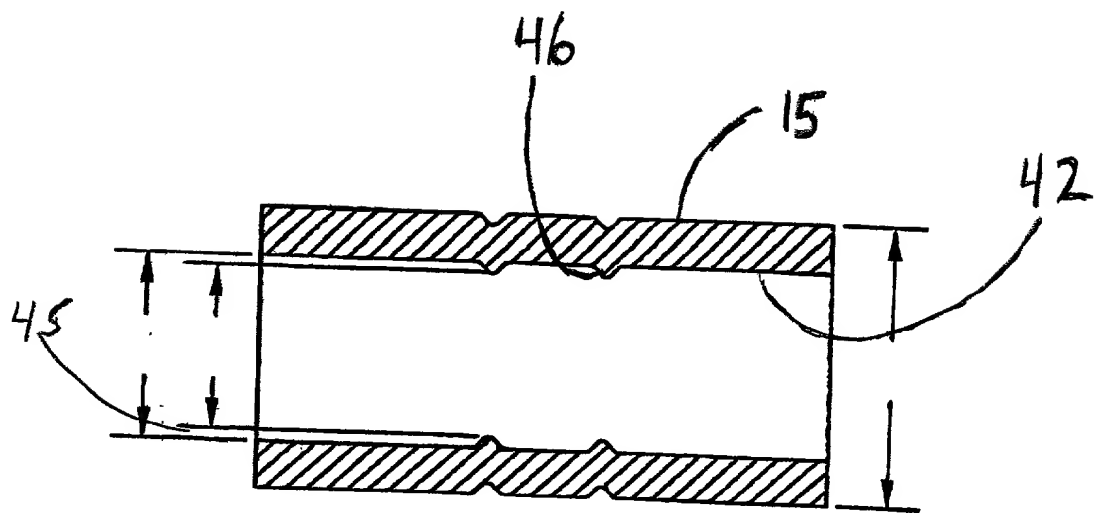


Fig. 6A

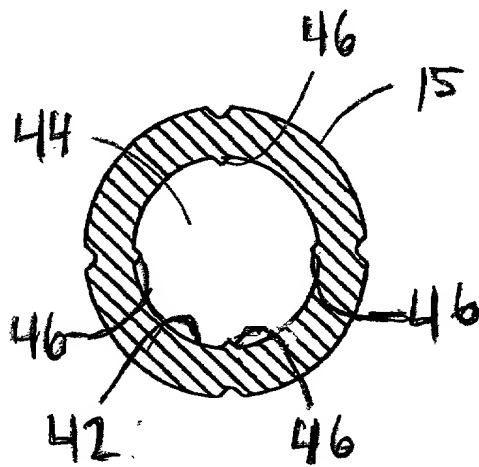


Fig. 6B

ATTORNEY FILE NO. 20000389.ORI

DECLARATION, POWER OF ATTORNEY, AND PETITION

I, BRADLEY J. WESSMAN, a citizen of the United States of America, residing at 17595 - 93rd Place North, Maple Grove, MN 55311, hereby declare that: my residence, post office address and citizenship are as stated above next to my name; and that I verily believe I am the original, first and sole inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled "MEDICAL LEAD AND METHOD FOR MEDICAL LEAD MANUFACTURE", the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the specification including the claims as amended by any amendment specifically referred to in the Oath or Declaration.

I acknowledge the duty to disclose information which is material to patentability in accordance with Title 37, Code of Federal Regulations, Section 1.56.

I hereby appoint NIKOLAI, MERSEREAU & DIETZ, P.A., a professional association, consisting of the following attorneys/agents and the following attorneys/agents individually: Thomas J. Nikolai, Registration No. 19,283; Charles G. Mersereau, Registration No. 26,205; Paul T. Dietz, Registration No. 38,858; Steven E. Kahm, Registration No. 30,860; and Kevin W. Cyr, Registration No. 40,976, of 820 International Centre, 900 Second Avenue South, Minneapolis, Minnesota 55402-3813; Telephone No. (612) 339-7461, my attorneys/agents with full power of substitution and revocation to prosecute this application and transact all business in the Patent and Trademark Office connected herewith.

Please direct all telephone calls and correspondence to: Kevin W. Cyr, Esq. at NIKOLAI, MERSEREAU & DIETZ, P.A., 820 International Centre, 900 Second Avenue South, Minneapolis, Minnesota 55402-3813.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Date: September 21, 2020

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